
Table of Contents

F01 BMW Night Vision 2

Subject	Page
Introduction	3
System Overview	5
System Circuit Diagram F01/F02	5
Connection of Control Units and Camera	7
PT-CAN	7
System Functions	8
The BMW Night Vision 2 System Principle	8
Principle of Pedestrian Detection	9
Various Forms of Indication	11
Availability Indicator in CID	12
Symbols in HUD (Head-up Display)	13
Warning in Vehicles w/out HUD	13
Sequence of signals	13
Switch-on Conditions	14
Operation by iDrive	15
Calling Up Menu	15
Contrast and Brightness	15
Pedestrian Detection	16
Visibility	16
System Components	17
Night Vision 2 Camera	18
Night Vision 2 Control Unit	19
Service Information	20
Adjusting Camera Pivot Position	20
Changing Protective Window	21
Replacing Camera Washer Jet	21
Displays Indicating Defective System	22
Programming and Coding	22
Initializing Software	22

BMW Night Vision 2

Model: F01/F02

Production: From Start of Production

OBJECTIVES

After completion of this module you will be able to:

- Describe the Night Vision 2 System in the F01/F02
- Describe the functions of the Night Vision 2 System in the F01/F02
- Identify the components of the Night Vision 2 System in the F01/F02

Introduction

The BMW Night Vision 2 system provides the driver with a black-and-white image of the driving environment ahead of the vehicle in the control display CD or central information display CID.

BMW Night Vision 2 is a passive system without active infrared illumination. Objects situated ahead of the vehicle are shown in varying degrees of brightness depending on the temperature of these objects. This enables the driver to detect in good time heat-emitting objects such as, for example, persons, animals and other vehicles.

This thermal image is recorded with a Far Infrared camera (FIR) via a special imaging sensor which detects the infrared radiation in a specific wavelength range.

Intelligent algorithms in the control unit makes it possible to automatically detect persons in the image. Following evaluation of distance and direction of movement, a symbol on the central information display CID and in the head-up display HUD warns the driver of any persons at risk.



The BMW system is distinguished from infrared systems by its robust resistance to dazzling, its long range and its clearly structured image.

The system offers the customer the following advantages:

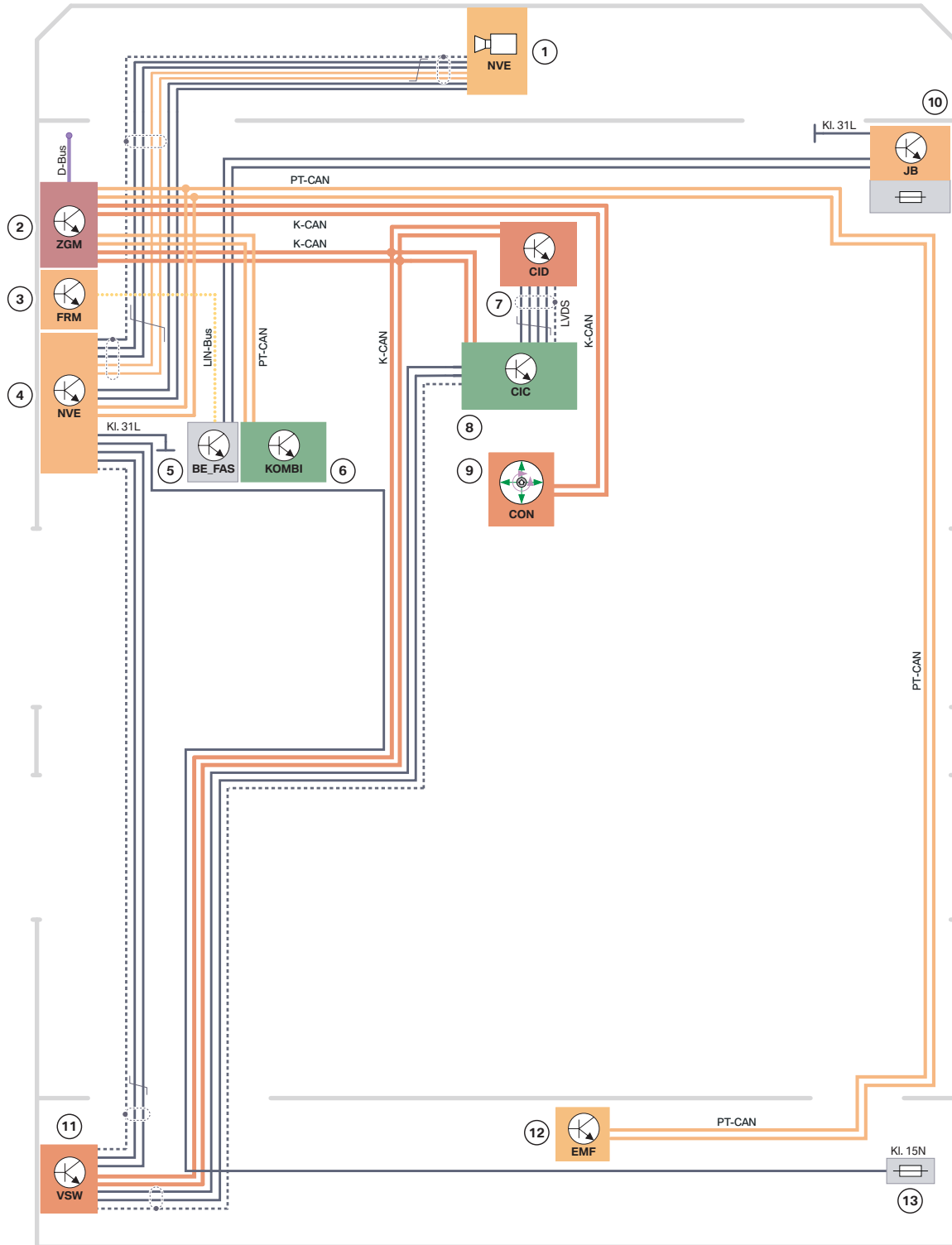
- Highlighting of non-illuminated, heat emitting objects such as pedestrians, cyclists, vehicles and animals.
- Better overview of the driving situation thanks to the depiction of the route of the road beyond the headlight cone.
- Improved vision in twilight (dawn/dusk) and darkness.
- Symbol warning of persons at risk in the area ahead of the vehicle.
- No dazzle in the screen image caused by the headlights of oncoming vehicles.
- Display of dark courtyard and garage entrances.

Night Vision 2 is designed as a supporting system, which, with a modified driving style, affords the driver a better overview of the road conditions ahead of the vehicle.

Note: The driving speed must be adapted to the relevant visibility conditions.

System Overview

System Circuit Diagram F01/F02



Legend for System Circuit Diagram F01/F02

Index	Explanation	Index	Explanation
1	Night Vision 2 camera	11	Video switch (VSW)
2	Central gateway module (ZGM)	12	Electromagnetic parking brake (EMF)
3	Footwell module (FRM)	13	Power distribution box, rear right
4	Night Vision 2 control unit (NVE)	PT-CAN	Powertrain controller area network
5	Control panel, driver assist systems (BEFAS)	K-CAN	Body controller area network
6	Instrument cluster (KOMBI)	LIN-Bus	Local Interconnect Network bus
7	Central information display (CID)	D-Bus	Diagnosis bus
8	Car Information Computer (CIC)	KI.31L	Terminal 31, ground
9	Controller (CON)	KI.15N	Terminal 15, after running (voltage)
10	Junction box (JB)		

Connection of Control Units and Camera

The Night Vision 2 control unit and the night vision camera are connected through the following cables:

- Private CAN-bus; Diagnosis, programming and camera control
- LVDS-Video; Video signal from the camera
- CAN_POW; Power supply from control unit to camera, heating of camera lens
- Ground; Common ground of camera and control unit for suppressing interference.

The video signal is sent via a shielded LVDS cable between the camera and control unit. In the control unit the signal is converted into an dCVBS (d = differential) video signal and, depending on the equipment specification, transmitted to the CIC or the video switch.

The camera is powered under the following conditions:

- BMW Night Vision 2 switched on by pressing button in control panel of driver assist systems BEFAS
- Rain-driving lights sensor detects twilight or darkness.

The BMW Night Vision 2 control unit is powered by the rear distribution box via terminal 15N.

PT-CAN

The PT-CAN connection of the Night Vision 2 control unit serves to transmit the diagnosis and programming data and to read out the information from the RLS (brightness), the JB (driving lights status, wiper speed) and ICM (road speed and yaw rate). In addition, the terminal status and the vehicle identification number (VIN) are transferred to the control unit via the PT-CAN.

System Functions

The BMW Night Vision 2 System Principle

The BMW Night Vision 2 camera is a heat image camera that converts thermal radiation into electronic signals.

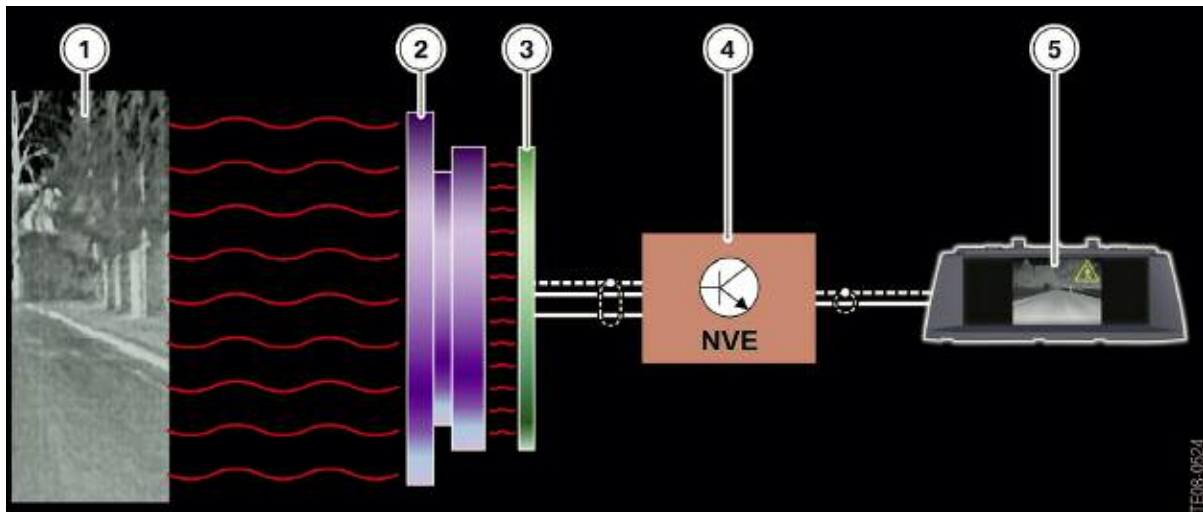
The thermal image is converted first by the sensor into electrical signals and then, with the aid of image-processing software, into a visible image in the control display or central information display.

The sensor elements alter the resistance in proportion to the temperature. The higher the temperature, the higher the electrical signal and the whiter the pixel will be shown.

Heat radiation is absorbed and dissipated by virtually every solid or liquid body. However, the heat emitted is not visible to the human eye because it is located in the long-wave infrared range. From a physical standpoint, this represents electromagnetic waves with a wavelength of 8 μm to 15 μm . This long-wave infrared radiation is known as Far Infrared (FIR).

The advantage of utilizing radiation in the far infrared range is the greater range compared with near infrared systems (NIR) with a wavelength of 0.7 μm to 1.4 μm . These systems additionally require illumination in precisely this wavelength. Essentially, FIR systems consist of an optical element, a thermal imaging camera, a control unit and a display.

The principle



Index	Explanation	Index	Explanation
1	Environment ahead of vehicle	4	BMW Night Vision 2 control unit
2	Optical element	5	Control display
3	Thermal imaging sensor		

The BMW Night Vision 2 system collects in its front lens the infrared radiation of heat-emitting objects such as persons, animals or vehicles in a specific wave range.

Principle of Pedestrian Detection

The Night Vision 2 control unit is equipped with three processors containing software, which, in addition to image processing for display, execute an automatic person detection function. The software searches the image for objects with human shape and classifies these objects as persons.

Their position, speed and distance to the vehicle are then determined. The risk level is analyzed based on these parameters as well as on the speed and yaw rate of the vehicle and a warning is triggered.

The warning for the driver, indicating persons at risk, is given in the form a corresponding symbol in the central information display CID or head-up display HUD.



Symbols in CID

These ranges change with increasing vehicle speed and follow the direction of the vehicle as a function of the current steering angle (yaw rate).

In order not to unnecessarily distract the driver not all persons identified in the image are signalled by a symbol. Only persons who are in a certain area directly in front of the vehicle are indicated by a symbol.

The system also warns of pedestrians located in an extended area to the left and right of the vehicle and are moving towards the central area (threat of collision).



Symbols in HUD

People who are within the central zone are always indicated. Persons in the extended area are only indicated if they are moving in the direction of the central area.

Under optimum conditions, the automatic pedestrian detection function operates at a distance of up to 100 m. At a driving speed in excess of 100 km/h (62 mph), the time between signalling and passing the person and therefore the reaction time for braking and evasive maneuvers is reduced.

Note: The pedestrian detection function is deactivated at speeds below 10 km/h (6mph). For more information regarding this feature refer to the Vehicle Owner's Manual.

Various Forms of Indication

The following table shows the different forms of indication in the two display instruments CID and HUD.

Situation	Indication in CID	Indication in HUD
No pedestrians in the danger zone.	 <p>TE08-0490</p>	 <p>TE08-0491</p>
There is a person at a great distance from the vehicle.	 <p>TE08-0492</p>	 <p>TE08-0493</p>
There is a person at a closer distance from the vehicle.	 <p>TE08-0824</p>	 <p>TE08-0495</p>
A person is crossing the road from right to left.	 <p>TE08-0496</p>	 <p>TE08-0497</p>
A person is crossing the road from left to right.	 <p>TE08-0498</p>	 <p>TE08-0499</p>

Availability Indicator in CID

The availability of the Night Vision 2 system can be restricted by environmental conditions such as heavy rain, extreme +/- temperatures or fluctuations in light conditions.



Availability indicator in CID

Note: Only non-availability of person detection function is indicated. The symbol corresponds to the "Pedestrian Detection" button in the function bar.

The possible situations for the availability indicator in the CID are listed in the following table.

Situation	Symbol	Display
The driver has activated the person detection function and the system is available		
The driver has activated the person detection function but the system is not available, the Night Vision 2 image is still shown		
The driver has deactivated the person detection function, the Night Vision 2 image is still shown		

Symbols in HUD (Head-up Display)

If a person is detected at a great distance inside the warning range of the system the pedestrian figure will be shown distinctly above the road symbol. This is referred to as long-distance warning.



Long-distance warning

If a person is detected in close range, inside the warning zone of the system, the pedestrian figure will be shown distinctly on the road symbol. This is referred to as short distance warning.



Short-distance warning

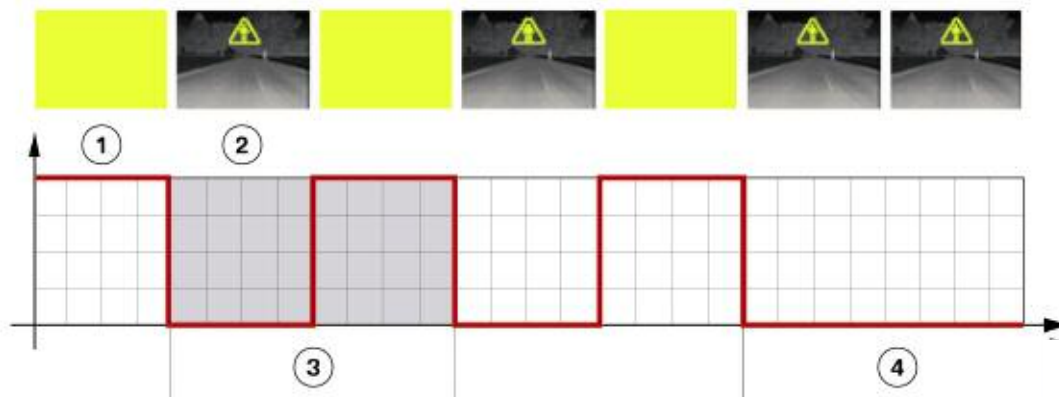
Warning in Vehicles w/out HUD

The warning symbol is shown on the CID in vehicles without HUD or with HUD deactivated. In addition, the CID initially flashes yellow 3 times when the warning comes on in order to catch the driver's attention.

The warning is shown as soon as a person enters the warning zone directly ahead of the vehicle or a person crosses the road from the left or from the right.

Sequence of signals

The following graphic shows the exact sequence of warning signals and is designed to illustrate the functional principle in connection with the table.



Functional principle

Functional principle legend

Index	Explanation
1	Yellow display
2	Normal display
3	Interval approximately 0.5 seconds
4	The warning symbol remains for as long as there is a pedestrian in the danger zone, but at least 3 seconds

Switch-on Conditions

The BMW Night Vision 2 is activated as soon as the button in the control panel of the driver assist systems BEFAS is pressed.

The following basic conditions can exist:

- The rain/driving lights sensor detects sufficient ambient light and the driving lights are switched off; BMW Night Vision 2 is ready for operation approximately 2 seconds after the button in BEFAS is pressed. A message is shown in the control display during this period of 2 seconds.
- The rain/driving lights sensor detects insufficient ambient light and the driving lights are switched on; BMW Night Vision 2 is ready for operation immediately after the button is pressed. BMW Night Vision 2 cannot be activated when
- The driving lights are switched off
- The rain/ driving lights sensor detects insufficient ambient light
- The driving speed is greater than 5 km/h (3 mph).

Once BMW Night Vision 2 has been activated, a message appears in the control display to the effect that the system cannot be used at night without headlights.



Night Vision 2 button in the BEFAS

Operation by iDrive

The individual functions and settings can be selected and activated through the iDrive.

The following settings can be selected on the F01/F02:

- Brightness
- Contrast
- Pedestrian detection.



BMW Night Vision 2 menu in the F01/F02

Calling Up Menu

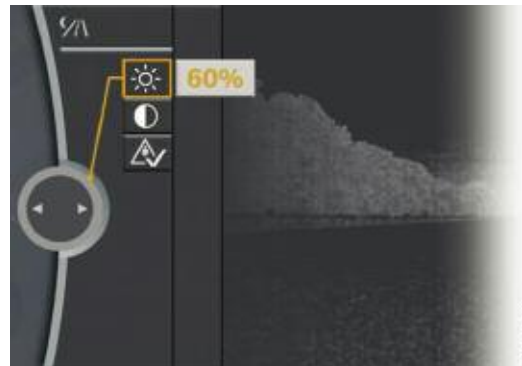
The "Night Vision 2" menu can only be selected if the system has been activated by pressing the button in the BEFAS.

Providing the preconditions have been met, the menu can be selected as follows:

- Press the controller, the "BMW Night Vision" menu is shown on the control display.
- Select the desired menu item, e.g. "Brightness", by turning the controller.
- Press the controller to activate the function.
- Set the required value and confirm by pressing.

Contrast and Brightness

Both values can be personalized and changed on a scale between 0 % and 100 %.



Adjusting brightness

Note: For detailed information on the operation and functions of the Night Vision 2 System refer to the vehicle Owner's Manual.

Pedestrian Detection

The person detection function can be activated and deactivated.

Visibility

The illumination range in front of the vehicle with low beam is less than 50m/54yd.

Normal driving light illumination by fitted halogen headlights is 100m/109yd.

The high beam illumination range provided by xenon headlights is 150m/164yd. However, people can only be detected in this range if they are wearing reflective clothing.

Night Vision 2 will detect heat-emitting objects in the image up to a distance of about 300m/328yd, regardless of the amount of reflection their clothing gives off.

Automatic pedestrian detection has a maximum range of 100m/109yd. This specified distance is dependent on weather factors.

The range of vision is also reduced in the Night Vision 2 image in the case of thick fog or heavy rain. Night Vision 2 is designed as a supporting system, which provides the driver a better overview of the road conditions ahead of the vehicle.



Activating/deactivating person detection

Comparison of BMW Night Vision 2 range of vision with different headlights



Note: The driving speed must be adapted to the relevant visibility conditions.

System Components

The BMW Night Vision 2 system consists of the camera, control unit, camera washer jet, button and the sensor system.

The BMW Night Vision 2 system consists of the following components:

- Night Vision 2 camera with camera bracket in the kidney grille and camera washer jet
- Night Vision 2 control unit
- Button in BEFAS
- Sensor system



Installation locations - Night Vision 2, BMW 7 Series, F01/F02

Index	Explanation
1	Night Vision 2 camera
2	Night Vision 2 control unit
3	Button in control panel of driver assist systems BEFAS

Night Vision 2 Camera

The thermal imaging camera consists of a heated protective window, optical element and a thermal imaging sensor. The thermal imaging sensor is made up of a multitude of sensor elements.

Each display pixel is assigned one such sensor element. The sensor elements generate an electrical signal as a function of the impinging intensity of heat radiation.

The higher the temperature, the brighter the corresponding pixel will be displayed. The heat radiation is converted into electrical signals on the basis of the principle of a change in resistance.

The image can be replaced up to 30 times per second. In order to ensure an image of consistent quality, it is necessary for the camera to be calibrated approximately every 120 - 180 seconds. This calibration can take up to approximately 0.3 seconds. For this reason, the image may be seen to freeze briefly in the display.



The Night Vision 2 camera is mounted with a bracket directly behind the left kidney grille. The camera is equipped with a sensor which detects heat-emitting objects in the far infrared range (wavelengths from 8 μm to 14 μm). The camera resolution is 324 x 256 pixels.

The maximum angle of view is 24°. The camera operates in an ambient temperature range of -40°C/-40F to +80°C/176°F. The imaging sensor is thermally insulated to provide protection against heat influences from the camera surroundings.

The washer jet is screwed to the camera bracket and is situated directly below the protective window. It is directly connected to the headlight washer system and therefore operates in connection with it.

A heater element is incorporated on the inside of the protective window to prevent it from misting over or freezing up. The heater is located at the edge of the protective window outside the camera's field of vision.

Night Vision 2 Control Unit

The control unit is installed behind the compartment in the area of the A-pillar directly under the light switch cluster.

The control unit calculates the displayed 720 x 480 pixel image from the 324 x 256 pixel raw data image supplied by the camera. Automatic pedestrian detection is executed in the control unit. The diagnosis, programming and coding data are also transmitted to the camera through the control unit.



BMW Night Vision 2 control unit

The camera and the protective window heater are powered via the control unit. The raw image data from the camera are transmitted through a LVDS cable to the control unit.

The image output by the control unit is made available in the head unit in the form of a dCVBS signal.

The camera-housing cover features a 6-pin plug connection.



6-pin plug connection

The button for switching BMW Night Vision 2 on and off is integrated in the BEFAS.

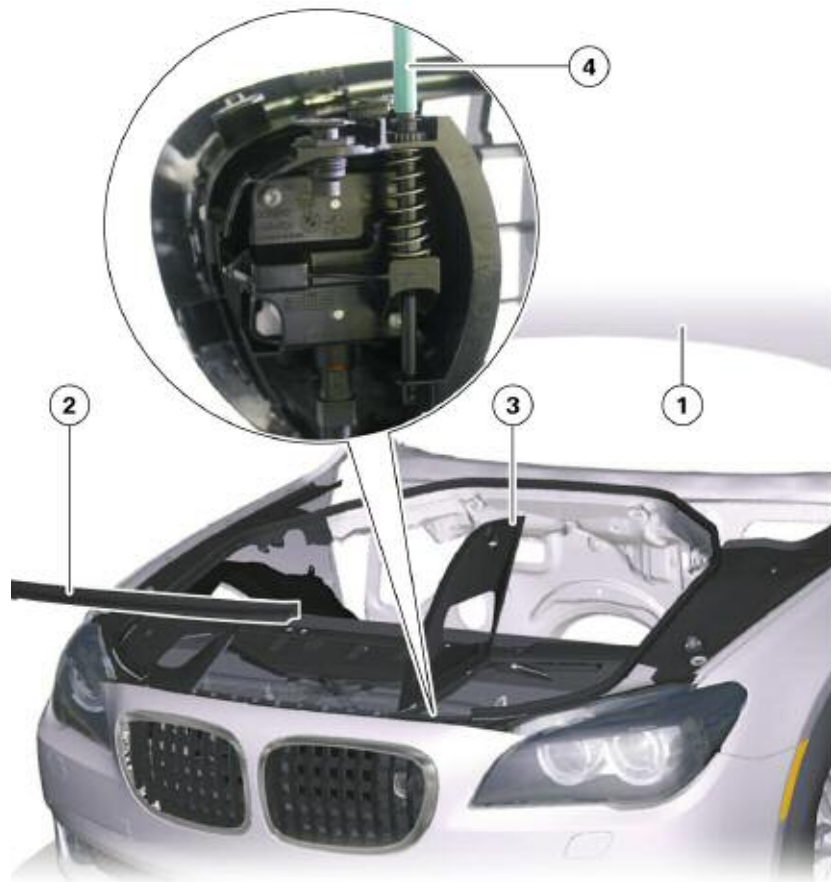


Button in the BEFAS BMW 7 Series

Service Information

Adjusting Camera Pivot Position

The pivot position of the camera can be adjusted by means of an adjusting screw at the bracket.



Camera alignment

The following steps must be taken to adjust the camera on the F01/F02:

- Open hood(1).
- Remove sealing lip (2) on front panel.
- Open headlight cover (3).
- Position headlight adjustment unit with spirit level in front of vehicle.
- Insert Allen key (4) through the opening in the front panel and set the camera to the required position; the line in the image must be parallel to the spirit level.
- Reassemble all parts that have been removed in reverse order.

Changing Protective Window

In the event of damage the camera protective window can be replaced.



Replacing front lens

Replacing Camera Washer Jet

A washer jet with a direct connection to the headlight washer system for cleaning the protective window is mounted on the camera.

Follow the procedure below to replace the washer jet:

- Remove bumper panel.
- Remove left-side kidney grille.
- Undo two recessed cross head screws (1).
- Release the hose clip on the connecting hose to the headlight washer system and remove the washer jet towards the front.
- Reinstall all parts that have been removed in reverse order.



Camera washer jet

Note: Camera alignment is only possible with a BMW diagnosis system. For detailed information on how to service the Night Vision 2 camera, lens or washer jet please refer to the Repair Instructions available in TIS.

Displays Indicating Defective System

In the event of a system defect, the following warnings are shown in the F01/F02:

- Check Control message in the instrument cluster.
- The same Check Control message in HUD if installed.



Display indicating defective system

Programming and Coding

Initializing Software

When replacing the camera, it is always necessary to initialize the software by entering an enable code (FSC).

Note: The vehicle identification number (VIN) must always be entered when ordering a new camera or a new control unit.

The camera is programmed by through of the control unit. The control unit receives the programming data for the camera through PT-CAN. The control unit forwards this data to the camera through the "private CAN-bus".